Blazars

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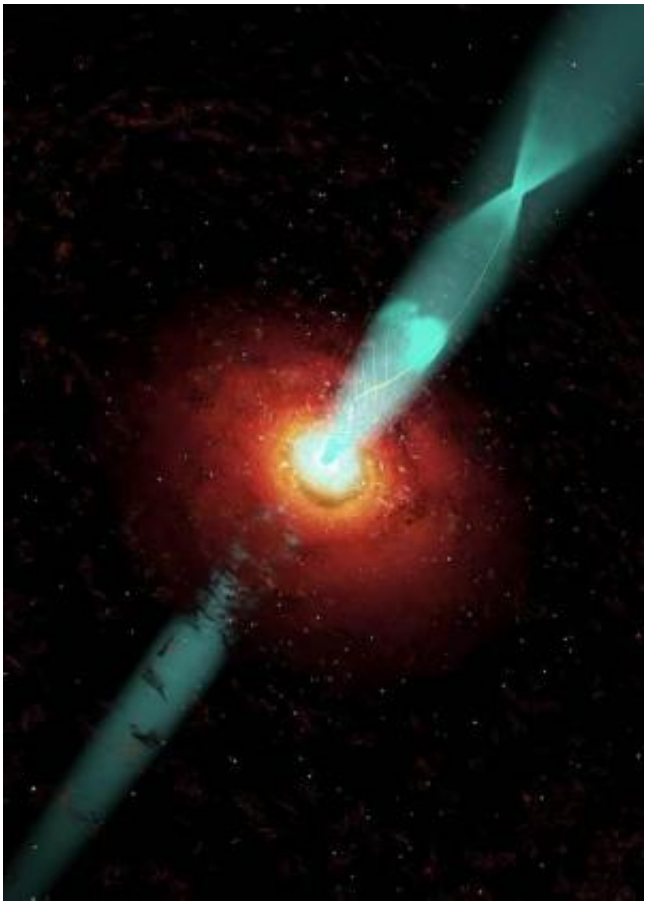

An artist's conception of a blazar, whose powerful jet of high velocity particles is generated around a supermassive black hole and aimed almost directly at Earth. A new CfA study has discovered that the infrared colors of blazars are a distinctive and powerful diagnostic tool. Credit: Marscher et al., Wolfgang Steffen, Cosmovision, NRAO/AUI/NSF

(PhysOrg.com) -- A blazar is a galaxy which, like a quasar, has an

intensely bright central nucleus containing a supermassive black hole. In a blazar, however, the emitted light sometimes includes extremely high energy gamma rays, sometimes over a hundred million times more energetic than the highest energy X-rays that the Chandra X-ray Observatory can study. The overall emission has several other unique properties as well, including that its intensity can vary dramatically with time.

Astronomers suspect that this bizarre behavior results when matter falling onto the vicinity of the massive black hole erupts into powerful, narrow beams of high velocity charged particles. The intense X-ray and gamma ray emission we see, and the variability as well, are thought to be the results of our fortuitously staring right down the throats of such cosmic monsters. But blazars are among the rarest of active nuclei, with only about 2700 known, and the physical processes that trigger and sustain such jets are still not known. Although relatively few, their powerful emissions make them major contributors to the overall picture of the cosmos.

CfA astronomers Francesco Massaro, Raffaele D'Abrusco, Josh Grindlay, and Howard Smith, and a colleague, have come up with a new method to find and study blazars. The recently launched NASA Wide Infrared Survey Explorer (WISE) satellite has just completed an infrared survey of the whole sky in four infrared colors. The astronomers matched galaxies known to be blazars with objects measured by WISE in regions of the sky where the data have been reduced and made public. In a new paper in The Astrophysical Journal, the team report their discovery that the infrared bands are remarkably effective at finding blazars. Ninety-seven percent of known blazars were easily picked out from thousands of other WISE sources because their colors in the infrared are different from the colors of other kinds of galaxies. In most galaxies the infrared radiation comes from dust, heated either by star formation or ultraviolet radiation from the vicinity of the massive black

hole. In a blazar, however, a completely different mechanism is apparently at work: the ejected beam of charged particles, moving in a powerful magnetic field at nearly the speed of light, radiates infrared light of a distinctly different color than dust emission.

Using this new identification method, the team examines one known, extreme gamma ray source whose character had been mysterious in part because the gamma ray detection could not pinpoint the precise position of the source on the sky. The scientists find an infrared source within the position uncertainty whose distinct colors mark it as a blazar, and conclude that the extreme source is probably a blazar located at the position of the infrared source. In a second paper, the astronomers take advantage of this new method to examine the subset of blazars that are gamma ray emitters. It turns out that the infrared colors of this extreme group are even more distinctly identified, and the team discovered a quantitative relationship between the infrared and gamma ray colors. A future paper will consider the physical mechanism(s) producing the infrared, X-ray, and gamma ray emission. The discovery of the distinct infrared colors of blazars opens a new diagnostic tool in the study of these extreme galaxy nuclei.

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